

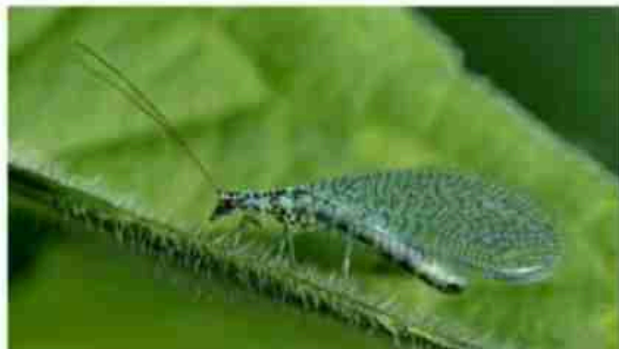
Neuroptera

- The Neuroptera is one of the oldest insect order.
- Complete metamorphosis.
- 6000 species distributed among 17 families.
- Occur in a variety of habitats throughout the world and their habits are diverse and interesting.
- Delicate bodies. Transparent, and pale green membranous with green wings.
- Includes the green and brown lacewings, antlions, owlflies, dustywings, mantidflies, and allies.

Introduction

Green Lacewing (*Chrysopidae*)

- One of the largest families of Neuroptera.
- Green lacewing (scientifically known as *Chrysoperla rufilabris*).
- Used to control many different pests.
- Chrysopidae, with its approximately 1200 recognized species.
- The larvae of many chrysopid species feed on Aphid.
- Because of biological control, chrysopids are the most frequently studied of the Neuroptera.



Introduction

Brown Lacewing (*Hemerobiidae*)

- The third largest neuropteran family, with approximately 550 species.
- *Hemerobiidae* constitutes a cosmopolitan clade that is relatively well known and easily recognized.
- Adults are generally small, brown, and inconspicuous.
- These insects differ from the somewhat similar Chrysopidae (green lacewings) not only by the usual coloring but also by the wing venation.



Morphology

- Medium-sized or large insects.
- mostly greenish appearance.
- Fore wing length of 6–35mm.
- Long filiform antennae, strong mandibles and cursorial legs.
- The wings are large, Compound eyes.
- Venation is usually green, but some veins in a few species are dark.
- Eggs are normally stalked up to 3mm in length and elongate oval in shape. The length of the stalk compared to the length of the egg differs widely and is characteristic for the species.
- Eggs can be deposited singly or in loose groups or in clusters.



Morphology

- Adult lacewings have 2 pairs of wings and chewing mouthparts.
- They also have long, thin bodies, and resemble dragonflies, but lacewings hold their wings over their backs when they are not flying: dragonflies are unable to fold their wings over their bodies.
- The wings of these insects are lace-like, with a dense network of veins and cross veins. There are two common families of lacewings in Kentucky: green lacewings (family Chrysopidae) and brown lacewings (family Hemerobiidae). Other than color, they are very similar in appearance. Like all insects, lacewings have 3 body parts, 1 pair of antennae, and 6 legs.
- Lacewing larvae resemble small caterpillars, but move more quickly, have longer legs, and have long, sickle-shaped mouthparts.

Neuropteran communities in Natural habitats

- Neuropteran communities in natural habitats are influenced by various biotic and abiotic factors, such as: plant associations, prey animals and parasites, temperature, wind, rainfall.
- Most of the Neuropteran species are found in woodland or shrub habitats and only a few in grass dominated vegetation.

Neuropteran communities in agricultural ecosystems

- Agricultural ecosystems are mainly defined by monocultural conditions, which provide food and shelter for a few well-adapted species covering a wide range of diversity. This is especially the case for phytophagous species.
- The feeding habits of Hemerobiidae and Chrysopidae: while Hemerobiid adults mainly feed on aphids, adult Chrysopidae are mainly phytophagous. Because the larvae of both families feed on plant-sucking insects and mites.

Neuroptera in integrated control programs

- The first efforts to industrialize the use of **Neuroptera as beneficial predators** were made at the beginning of the 20th century, when Bodenheimer and Gutfeld (1929) studied *Symphorobius fallax* (brown Lacewing) against *Pseudococcus citri* (*Planococcus citri*) in citrus orchards. Although the results of this test were impressive, 20 years elapsed before Douth and Hagen (1949) reported the efficient control of *Pseudococcus maritimus* on pears by using eggs of *Ch. carnea*.
- A **mass-rearing method** for this species was developed by Finney (1948). Since that time several modifications in mass rearing of Neuroptera, namely *Ch. carnea*, have been developed (Barnes, 1975; Hassan, 1975; Ridgway et al., 1970; Tulisalo, 1984), leading to industrial mass-production of this species. **Adults are mass-reared on artificial diets consisting of yeast, fructose, milk or whey and other changeable ingredients.**
- **Biological control** by application of Chrysopidae is used as a **biological agent against various species of aphids** on different vegetables.

Ecology

- Neuropteran species used as general feeders.
- Many of them preferring aphids as main prey organisms. These findings have been augmented through observations from laboratory rearing.
- Many different food sources such as jam, honey, pollen, yeast, cooked meat and different soft-bodied insects have been used as a food-source.

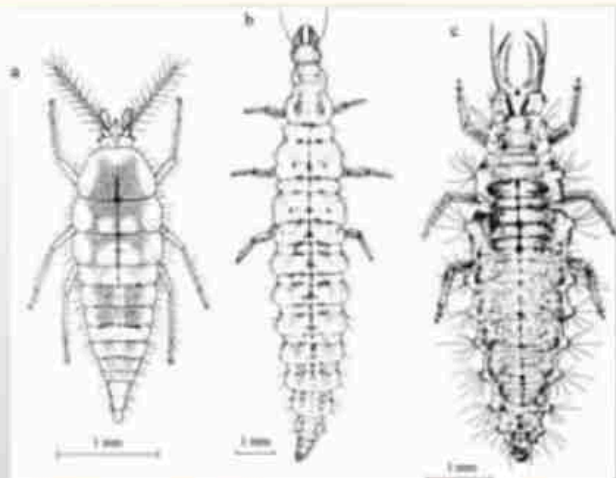


Ecology

- Larval green and brown lacewings are fast-moving predators that patrol plants for aphids, insect eggs, and other arthropod prey.
- They are voracious, feeding whenever they find food. Larvae use their sickle-like mandibles to suck fluids from their prey.
- Lacewing larvae are sometimes eaten by other creatures, such as spiders, lady beetles, and larger lacewings.
- Some lacewing larvae cover themselves with debris or with the remains of their prey as a way to camouflage themselves from larger predators.
- Green and brown lacewing adults are also predators and feed on the same prey as the larvae: aphids, insect eggs, etc. Because lacewing larvae are well-known for feeding on aphids, they are often called "aphid lions." Lacewing adults do not fly very well, and are often eaten by flying predators such as birds and dragonflies.

Ecology

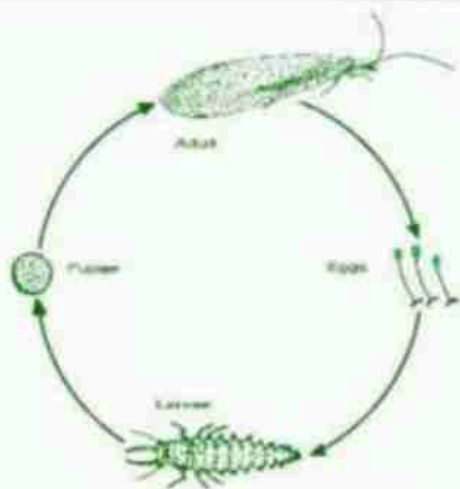
- Neuroptera show a high similarity in their feeding habits and only a few specializations can be found.
- Chewing–biting type and where only a few modifications throughout the families have taken place.
- In general three different types of feeding habits can be found in *Coniopterygids*(Dustywing), *Hemerobiids* and *Chrysopids*.



The third instar larva of *Conwentzia* sp. (Coniopterygidae) (a) (after Withycombe, 1923); *Hemerobius micans* (Hemerobiidae) (b) (original); *Ch. carnea* (c) (after Gepp, 1989).

Developmental Stages

- Lacewings have complete metamorphosis.
- After hatching from distinct, stalk-shaped eggs in late spring, the predatory larvae feed and grow for a few weeks, molting several times until they are ready for pupation.
- In the summer, the pupal stage lasts for a short time, allowing the adults to emerge, feed, mate, and produce additional generations of eggs before the end of the season.
- Pupae formed in fall will overwinter, with adults emerging and mating in the spring.



Eggs

- The Oval shaped green eggs are protectively laid singly at the end/tip of hair like long silken stalks about an inch high, fifth day of adult emergence, resembling miniature cattails growing from the plant foliage are pale green, turning greenish to white colour after 2-3 days than small larvae hatched out.



Larva

- The larvae which are very active, somewhat elongate, up to about a inch long when fully grown, broadest in the middle and tapered toward the rear.
- Gray or brownish and alligator-like with well developed legs and large pincers have sickle-shaped mouthparts, with which they suck the body fluids from the prey; feed on many types of soft bodied insects, including aphids, mealy bugs, scale insects, leafhoppers, and even small caterpillars.
- They grow from 1mm to 6-8 mm. They are also good predators of spider mites.



Pupa

- Mature third instars larvae spin round, pupate within spherical.
- parchment-like silken cocoons, usually in hidden places in plants.
- Adults emerge out after 8-10 days. Again the life cycle will start.



Adults

- The adult green lacewings have a soft, slender, pale green delicate body.
- they have large transparent, pale green membranous wings with green veins.
- long hair-like antennae and have bright, golden or copper-coloured eyes.
- The overall body length including wings is about 1 inch.
- These are active fliers particularly during the evening and night and have a characteristic, fluttering flight, sometimes this insect comes to light at night.
- They have a strong flight urge, may fly for 3 to 4 hours, feed on pollen, nectar and aphid honeydew.

